Constellation X

The Constellation X-ray Observatory

Wide-Field Calorimeter Concept

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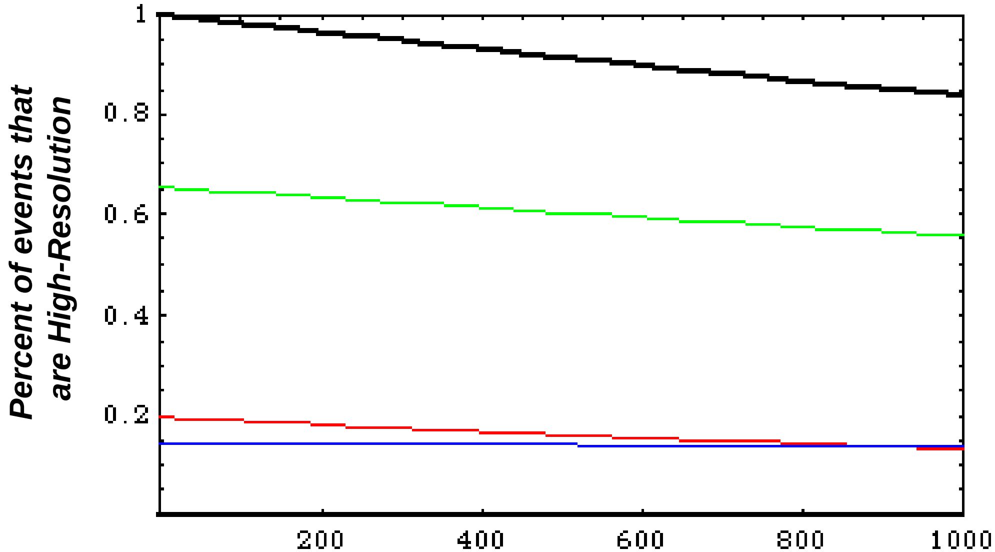
What can we do to increase the field of view of the XMS?

- **One of the limitations on the size of the XMS array is the number of electronic readout channels (SQUIDs)**
- **Energy resolution and throughput requirements place constraints on maximum number of SQUID channels**
- **Our strategy is to maintain the current baseline design while proposing an additional array that will be optimized for field of view.**
- **To increase the number of pixels, we look at technology extensions which may enable more SQUID channels for the same requirements.**
- **A further increase is obtained by relaxing the throughput and energy resolution requirements.**
- **Further increase in FOV could be obtained by using Position-Sensitive Devices.**

XMS-centric view of Optical Bench vs. Formation Flying

Issues	Optical Bench	Formation Flying
Count Rate	Limited by time constants -> affects FOV. 4 telescopes better than 1 telescope	Defocusing would greatly increase achievable count rate, and would offset the increase in count rate associated with 1 telescope.
Plate Scale	10-25 m Focal Length Ideal for 5” pixels	For 50 m Focal length, 5”pixels are harder, and may impact Energy Resolution. Physical size of array may limit FOV. 2.5” pixels are better.
Multiple Instruments	Would require mechanical translation stage	Easy with Formation Flying
Servicability	1 detector suite for the entire mission.	Can possibly upgrade detectors, add capability, etc.

High-Resolution events as a function of count rate

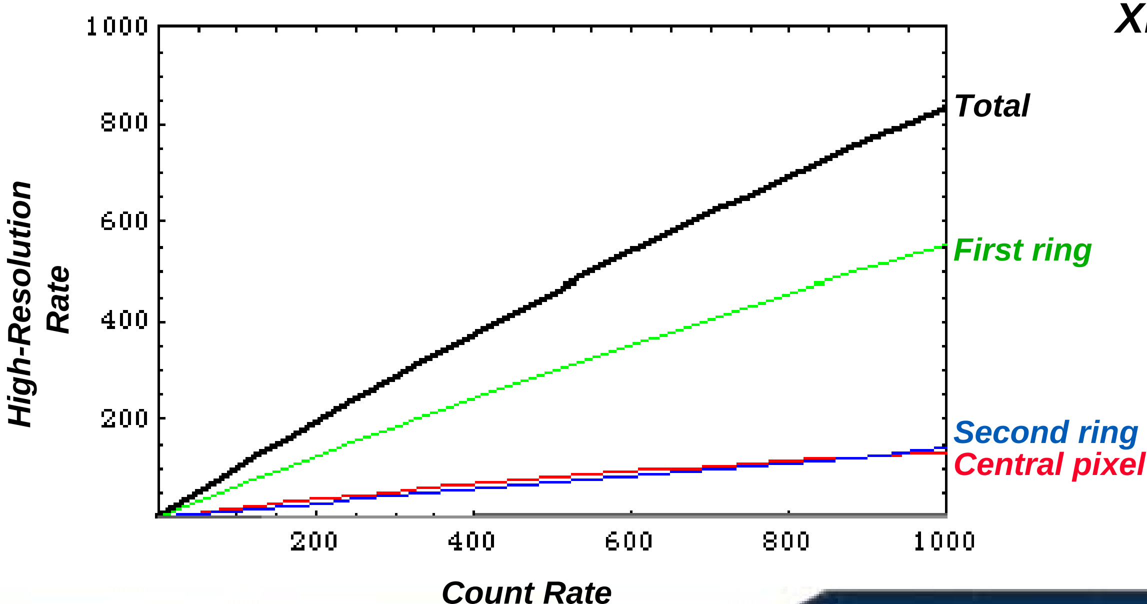


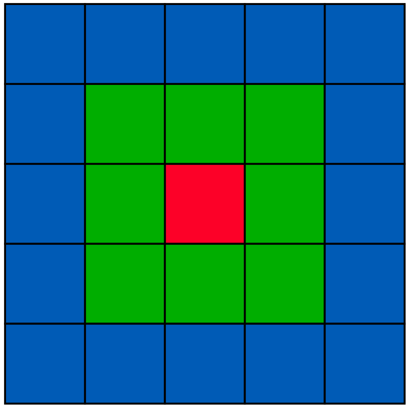
HPD = 10”   5” pixel

HPD = 5”   2.5” pixel

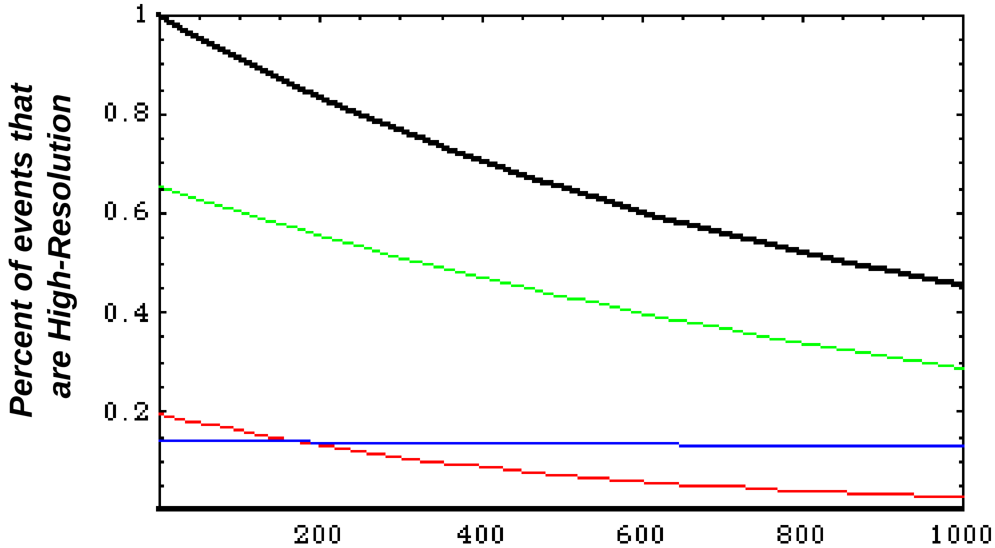
100 μsec decay time

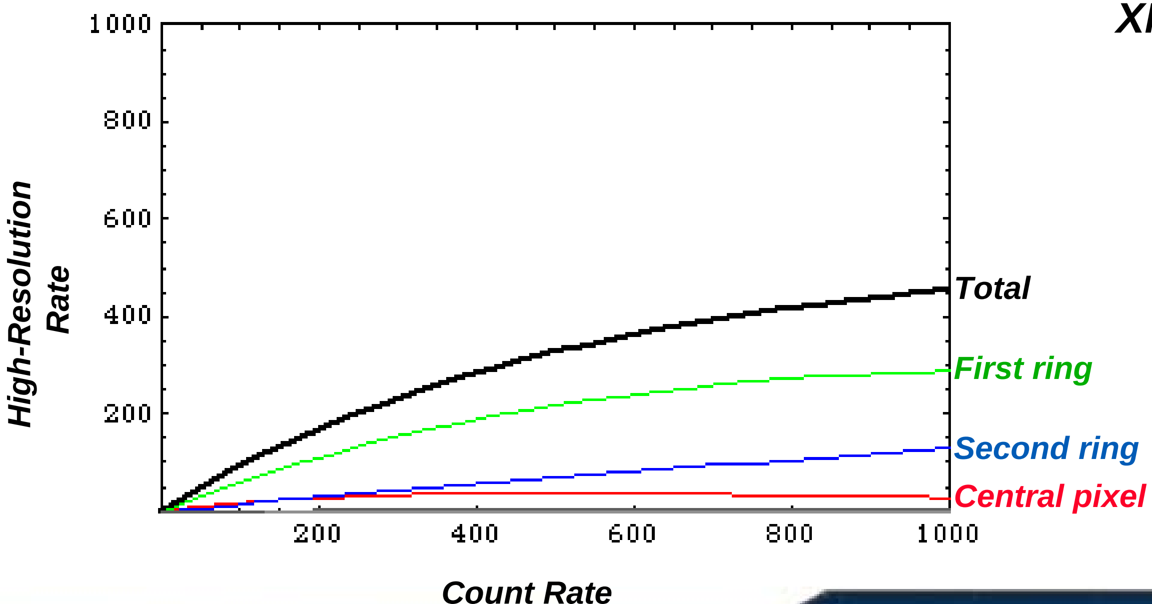
A 1 mCrab source puts 80 counts per second Distributed through the XMS array





High-Resolution events as a function of count rate



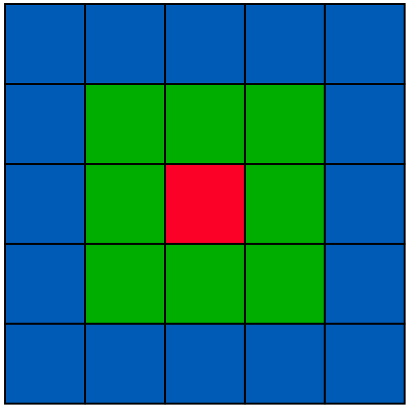


HPD = 10”   5” pixel

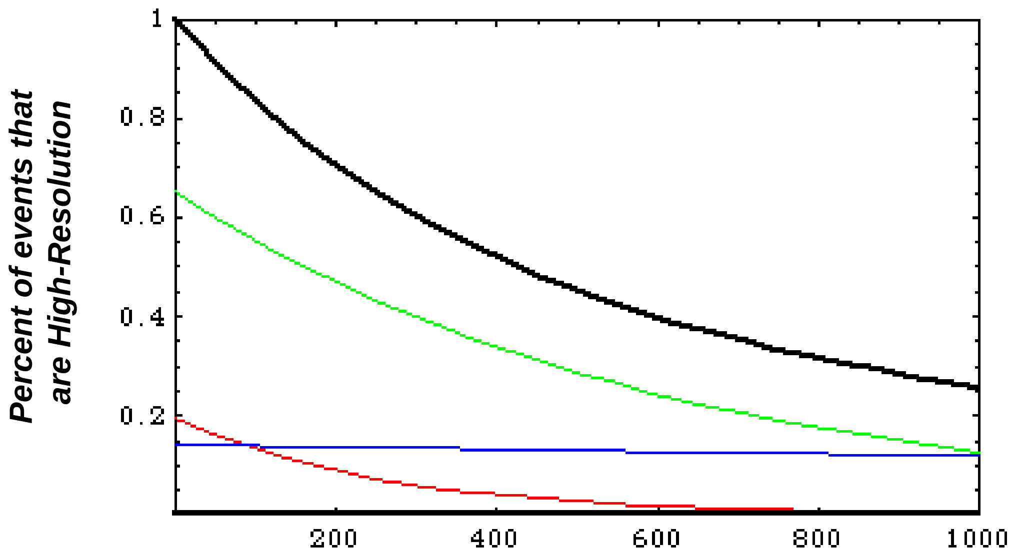
HPD = 5”   2.5” pixel

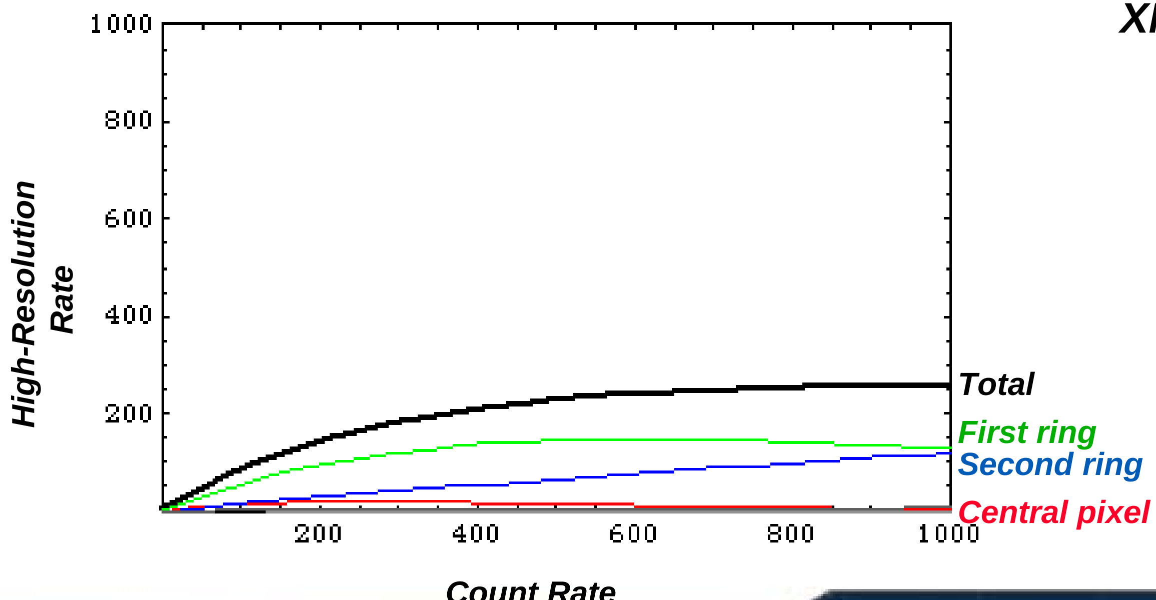
500 μsec decay time

A 1 mCrab source puts 80 counts per second Distributed through the XMS array



High-Resolution events as a function of count rate



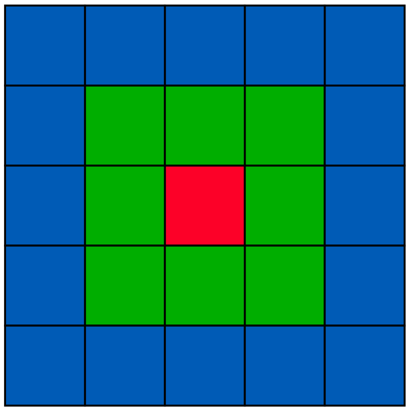


HPD = 10” 5” pixel

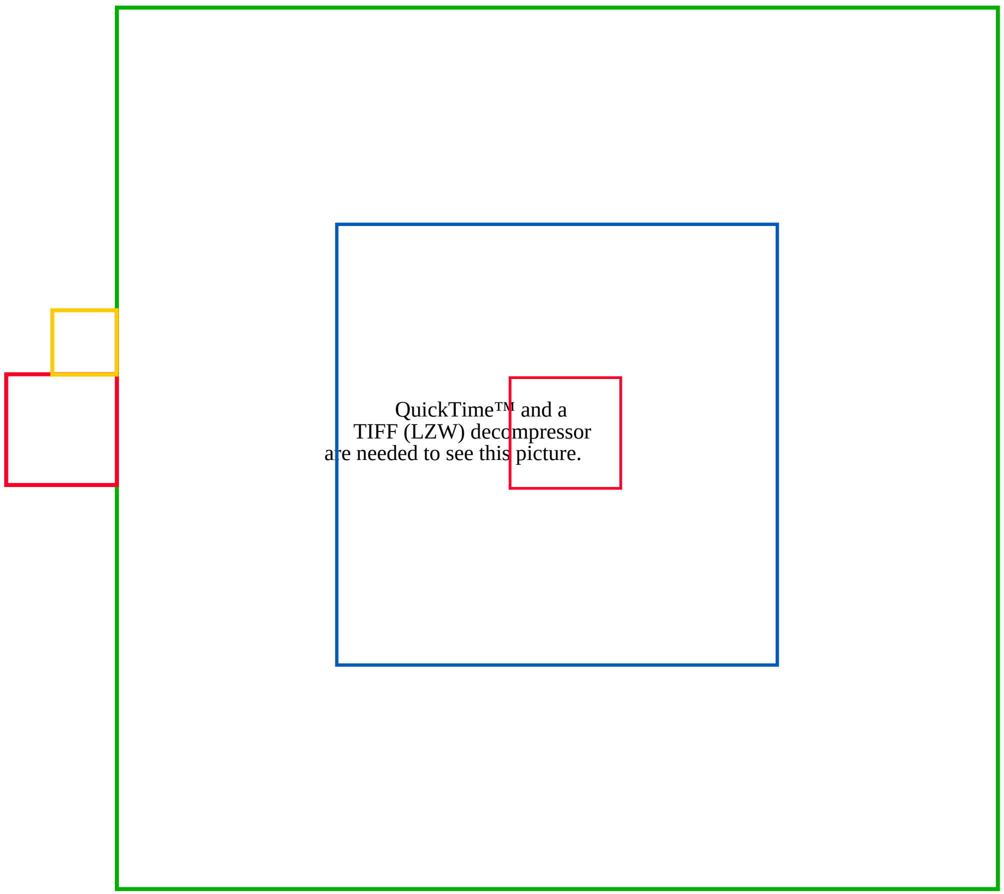
HPD = 5” 2.5” pixel

1000 μsec decay time

A 1 mCrab source puts 80 counts per second Distributed through the XMS array



XMS-W: A High-Energy-Resolution Wide-Field Camera Concept



Abell 2029

Baseline
32x32 1 kilopixel
2.5 arcmin Narrow-Field
High-Throughput
High-Resolution Imager
100 μsec decay time
2-4 eV FWHM

128x128 16 kilopixel
10 arcmin Wide-Field Camera
500-1000 μsec decay time
4 eV FWHM

256x256 65 kilo-pixel
20 arcmin Wide-Field Camera
Using Position-Sensitive Detectors
500-1000 μsec decay time
Four times lower maximum
countrate than 10 arcmin camera
5-8 eV FWHM

Soft X-ray Imager
TBD - 1 keV
0.5 eV FWHM @ 500 eV
100 μsec decay time

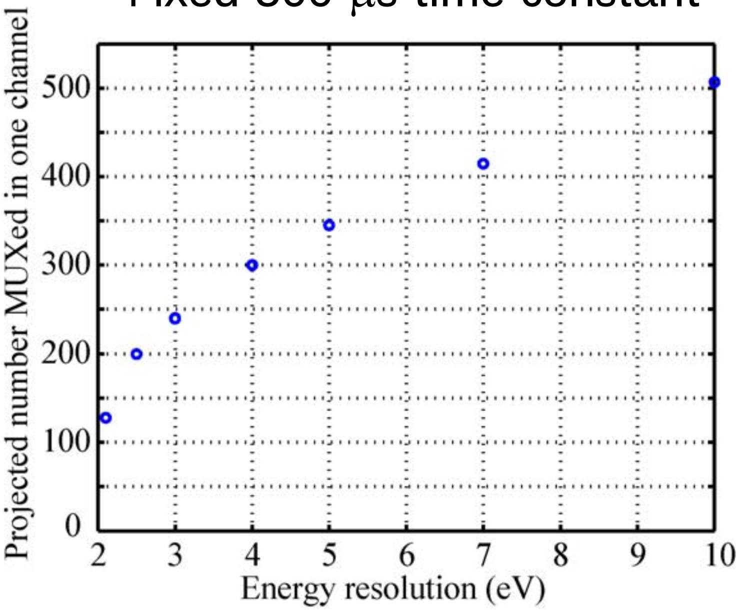
Assumes 5" pixels

Multiplexing very large TES arrays

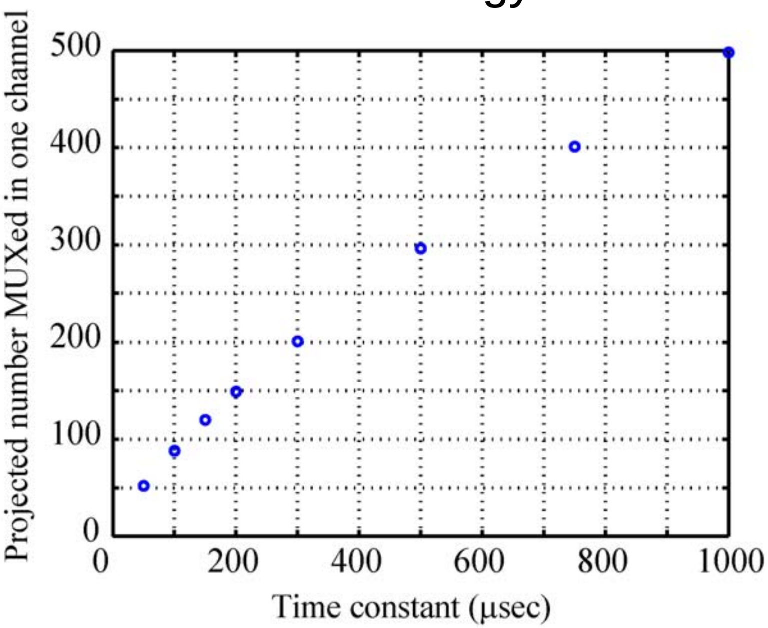
- Assuming 100 MHz open-loop bandwidth and fast room-temperature time-division electronics.
- Optimistic scaling from present circuits.
- Preliminary models – more detailed full system Monte Carlo models in process

The number of pixels MUXed per column vs. τ and energy resolution

Fixed 500 μs time constant



Fixed 4 eV energy resolution



A 128×128 array would potentially require a total of 8 HEMT amplifiers, 128 address lines, and 128 1st-stage SQUID feedback lines